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ABSTRACT

This report illustrates that measures of the effectiveness of teachers' implementation of a program can be derived from the instructions given to teachers on how to use the curriculum, that such measures can be used to improve the effectiveness of teacher training, and that better teacher training can be shown to lead to better learning on the part of students. By studying the relationships between behavior of teachers within curriculum programs and student outcomes, curriculum developers, publishers, and school personnel can have a significant impact on the development and assessment of teacher education programs and on modification of the curriculum materials themselves. Discussion is divided into four sections: a brief review of the research on teacher behavior within curriculum programs; a case study of the Distar instructional program, which illustrates how observational systems and measures of student gain can be used to establish relationships between instructional activities and pupil outcomes; suggestions for future research in curriculum programs; and implications of this investigation for preservice and inservice teacher education programs. (KS)

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Technical Report No. 9

Teacher Behaviors and Curriculum Packages: Implications for Research and Teacher Education

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Substantial resources are devoted each year to the in-service training of teachers to use curriculum materials in ways prescribed by the curriculum developers. Yet, the extent to which the teachers implement the curriculum is often not measured. Still less often does anyone determine if students learn more when the teachers follow the developers' instructions.

The first purpose of this chapter is to illustrate by means of a case study that:

-- measures of how well teachers are implementing a curriculum can be derived from clear and detailed instructions to teachers on how to use the curriculum;
-- such measures can be used to determine and improve the effectiveness of teacher training;
-- better teacher training can lead, and can be shown to lead, to better student learning.

The second purpose is to argue that curriculum developers, publishers, and school personnel--by studying the relationships between teacher behaviors within curriculum programs and student outcomes--can have a significant impact on the development and assessment of teacher education programs and on the modification of the curriculum materials themselves.

This chapter is divided into four sections: (1) a brief review of the research on teacher behavior within curriculum programs; (2) a case study from a particular curriculum package, illustrating how observational systems

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and measures of student gain can be used to establish relationships between instructional activities and pupil outcomes; (3) suggestions for future research in curriculum programs; and (4) implications of this research for teacher pre-service and in-service education programs.

A Summary of the Research

Curriculum research on teacher behaviors has focused on two types of instructional activities. First, there are those specific behaviors which are believed to be important for the success of a given program. Many of these prescriptions for behavior are found in curriculum guides, workshop manuals, and the writings of program authors. Second, there are those behaviors which are believed to be important for the success of a wide range of programs--that is, across all or most curricula or teaching situations. Teacher clarity, flexibility, enthusiasm, and use of student ideas are examples of program-general behaviors which have been studied (Rosenshine & Furst, 1971).

Program-specific and program-general teacher behaviors are not always mutually exclusive. That is, some behaviors which are specific to a particular curriculum may also be important for other programs as well. The distinction between these two types of instructional behaviors resides in the nature of the research. Curriculum-general studies examine those behaviors which may be important for the implementation and success of a wide range of curricula. Curriculum-specific studies, however, examine those behaviors which may be important for the implementation and success of a particular curriculum--irrespective of its importance for other curricula.

Curriculum-Specific Studies

Studies which have used observational systems to describe instructional activities considered important for the implementation of a curriculum program, have found wide variation between classrooms using the same program (e.g., Bissell, 1971; Gallagher, 1966, 1968; Katz, 1968; Lindvall & Cox, 1970; Niedermeyer & Dalrymple, 1970). For example, Gallagher (1966) studied the instructional behaviors of six teachers using the same unit from the Biological Sciences Curriculum Study (BSCS) program. The teachers had some previous BSCS training and their students had been selected on the basis of high ability. Three consecutive class sessions were recorded during the introduction of photosynthesis and analyzed by Aschner and Gallagher's topic classification system.

On almost all measures of teacher behavior there were significant differences among the six teachers. For example, one of the functions of class discussions, according to the BSCS developers, is to allow the student the opportunity to clarify and enrich his understanding of new concepts. In general, however, the teachers tended to speak three to four times as much as their students. When the focus of a topic in a class session was on description (defining or describing aspects of a concept or event), the amount of teacher talk ranged from 76% to 97%; when the focus was on expansion (leading the group off to other lines of thinking or encouraging new associations), the amount of teacher talk ranged from 67% to 100%; and when the focus was on explanation (focusing on reasoned argument through sequential deductive steps of thinking), the amount of teacher talk ranged from 59% to 91%.

Regretably, the investigator did not relate this variation in teacher behavior to changes in student learning or attitude. For example, what are the relationships between the amount of teacher talk and the student's increased ability to understand abstract biological concepts? Does an increase in the teacher's inquiry-strategy behaviors which are intended by the BSCS curriculum designers enhance or suppress student achievement, or is the effect negligible? Given a behavior that affects academic achievement, what are the concommitant effects in the pupil's attitude toward the study of biology, toward the teacher and school, or toward himself? These questions (and others) will have to be studied before effective training programs for BSCS teachers can be designed.

Curriculum-General Studies

While curriculum studies focusing on general instructonal activities attempted to relate these behaviors to gains in student outcomes, the observational instruments used were designed to apply to all types of programs and educational settings (e.g., Flanders, 1970; La Shier & Westmeyer, 1967; Soar, 1971; Soar & Soar, 1972; Soar, Soar, & Ragosta, 1971; Walberg, 1969). For example, Soar and Soar (1972) monitored eight classrooms in each of seven Follow-Through programs along with two comparison classrooms for each program. One day was spent in each classroom by a team of two observers. Instead of developing program-specific observation instruments, Soar and Soar used four general observational systems: the Florida Affective Categories (FLAC), a measure of "nonverbal expression of affect in the classroom, and the extent to which individual pupils or small groups of pupils [are] central in

classroom activities" (Soar & Soar, 1972, p. 234); the Teacher Practices Observation Record (TPOR), a measure of "the consonance of a teacher's practices with John Dewey's 'experimentalism' [and] teacher behavior that is widely practiced in the public schools" (Soar & Soar, 1972, p. 234); the Florida Taxonomy of Cognitive Behavior, a measure of different levels of intellectual activity such as memory, translation, interpretation, application, analysis, synthesis, and evaluation; and Ober's Reciprocal Category System, an expansion of the Flander's System and a measure of teacher and pupil talk.

The investigators correlated the ratings and counts (factor scores derived from the four observation instruments) with measures of gain in student learning (class mean residual gain). For example, Soar and Soar found that the factor representing "settings in which pupils are working in small groups or as individuals, work on a complex task is set by the teacher without continuing direction. . ., or pupil behavior or work has occasional close direction" (Soar & Soar, 1972, p. 246) correlated positively (r = .55) with gains in knowledge and manipulation of abstract subject matter.

It is plausible, however, that the most critical variables which affected pupil gains were not included in the general observational instruments. The ability to follow a pre-specified format without even minor deviations and to require unison group responses may be important variables in the Engelmann-Becker Follow-Through Model; whereas in the Educational Development Corporation (EDC) Program, the ability of the teacher to respond to the needs and interests of the children so as to form a rich and stimulating environment, may be essential to the realization of the program's goals and objectives. Yet, a general observation instrument is likely to be insensitive to these

program-specific variables. Therefore, in addition to observational instruments which reflect program-general or "across the board" instructional activities, development of observational measures which reflect those teacher and pupil behaviors most emphasized by the curriculum designers seems useful.

A Proposed Research Strategy

The following "descriptive-correlational-experimental-loop" research strategy (Rosenshine & Furst, 1973; Siegel, 1972, 1974) is a model for systematically approaching optimal teacher training programs, thereby influencing student learning. It attempts to correct the deficiencies of earlier curriculum research on teacher behaviors and is used as the basis for the case study presented in the second part of this chapter. The model has five phases:

1. Train a group of teachers to use the package of curriculum materials according to the authors' specifications. Most large-scale curriculum projects have developed materials which can be used for in-service training. Also, a careful examination of teacher guides often suggests guidelines for instructional behavior--presenting the materials, arranging the classroom environment, sequencing the lessons, reacting to student errors, and so on.

2. Develop and use observational systems to describe the instructional variables which are considered specific to the program and most emphasized by the curriculum planners, as well as the variables which are considered to have general educational importance (and which may or may not be emphasized by the curriculum designers).

3. Study the relationships between instructional activities and behavioral change in the students in a variety of outcomes (e.g., cognitive, affective).

At least the following ten questions should be asked:

a. To what extent were the instructional activities within the program those which were intended by the curriculum developers?

b. Did the classrooms (or other units) within the program differ in their use of instructional activities specific to the program?

c. Did the classrooms within the program differ in the use of general instructional activities considered important for student growth?

d. Were the classrooms within the program different on the outcome measures of interest?

e. What was the relationships between use of program-specific activities and student growth?

f. What was the relationship between general instructional activities and student growth?

g. Were there differences in student growth among classrooms of teachers who were high, average, or below average in their fidelity to the intentions of the curriculum developers?

h. Were there differences in student growth among classrooms of teachers who were high, average, or below average in their use of general instructional activities?

i. Were classrooms which were high, average, or below average in student growth different in their fidelity to the intentions of the curriculum developers?

j. Were classrooms which were high, average, or below average in student growth different in their use of general instructional activities?[1] (Rosenshine, 1971, p. 84)

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[1]Averaging implementation ratings across visits for those teachers whose ratings increase, decrease, or are erratic throughout the year (e.g., low, average, high; high, average, low; high, low, average; high, low, high) may be misleading. Describing the teachers as medium or average implementors is not as descriptive as perhaps "ascendant," "descendant," and/or "erratic." These patterns could also occur in student behavior if measures of student outcomes are taken at different intervals throughout the year.

4. Modify the training procedures, observation instruments, and/or curriculum materials on the basis of the correlational and quasi-experimental studies completed in phrase three. Perhaps some variables (e.g., a particular subset of teacher behaviors) are more predictive of changes in student outcomes than other variables. Perhaps certain variables suggest that some of the basic assumptions of the training program or curriculum materials are in doubt.

5. Retrain some or all of the teachers. Conduct new studies to determine the effects of the modifications and to determine the new relationships between instructional activities and student learning. By recycling through phases one through four, the curriculum designer, publisher, and researcher successively approximate optimum training procedures and curriculum materials, thus affecting gains in student achievement or other measures of interest.

Further problems and suggestions for developing measures of instructional activities and student outcomes, designing research studies, and analyzing data are presented elsewhere (see, for example, Flanders, 1970; Gage, 1969; Medley & Mitzel, 1963; Rosenshine, 1970, 1971; Rosenshine & Furst, 1971, 1973; Tatsuoka, 1972).

An Example of Research on Teacher Behaviors Within a Curriculum Program

One "pass" through the above "descriptive-correlational-experimental-loop" research paradigm has been completed with the Distar® Instructional System. The focus in this section will be on describing this curriculum package, illustrating the development of the program-specific observation system used in the research, reporting the summary findings, and describing implications of this research for training Distar teachers.

Description of the Distar Instructional System

One of the most successful (McDaniels, 1975; Becker & Engelmann, 1974; Office of Education, 1974; Stallings & Kaskowitz, 1974; Becker & Engelmann, 1973; Science Research Associates, 1971a) and controversial of all the early childhood and primary grade curriculum materials programs is the Distar Reading, Language, and Arithmetic programs (Engelmann & Bruner, 1969, 1970, 1974; Engelmann & Carnine, 1969, 1970, 1972, 1974; Engelmann & Osborn, 1970, 1972; Engelmann, Osborn, & Engelmann, 1969; Engelmann & Stearns, 1972). These programs are the principal materials used in the Engelmann-Becker Follow-Through Model.[2] Unlike other programmed materials, the Distar program is not a self-instructional program. Instead, the teacher follows a carefully structured and logically sequenced teaching program. The presentation books provide the teacher with a script--a series of demonstrations and tasks--to be presented word for word. The teacher's role thus changes from one of designing instruction to one of teaching a particular format to criterion (mastery), involving all of the children in the instruction, correcting mistakes, providing feedback, and reinforcing the children's responses.

A typical first-grade classroom is divided into three groups of children, "homogeneous" by achievement, with the daily lesson being presented to each group separately. A thirty-minute lesson consists of a series of group and individual tasks or activities. Once the teacher obtains the children's

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[2]For a more complete description of the philosophy and methods used in the Engelmann-Becker Program, the reader is referred to Engelmann (1969a, 1969b) and Maccoby and Zellner (1970).

attention, she proceeds with the first task, following the format as written in the presentation book. The students respond. The teacher then evaluates their answers: inappropriate responses are corrected according to a pre-specified correction paradigm and appropriate responses are praised. After all of the tasks in the lesson have been presented in this manner, the teacher presents reinforcement material in the form of "take-homes." The children's performance on the "take-homes" also provides feedback to the teacher and parent. During the next session, the group moves on to the tasks in the following lesson.

An example of a lesson format appears in Figure 1. This task is one of many in Distar Reading I (Engelmann & Bruner, 1974). Its purpose, along with other formats, is to teach the children to sound out a word, say it fast, and identify the word.

Insert Figure 1 about here

Teacher Implementation Variables

Since the first Distar program was published by Science Research Associates in 1969, certain basic assumptions as to how the teacher should behave when implementing the curriculum materials have been stated explicitly. Five areas of teacher behavior are emphasized throughout teacher guides and training manuals. (Notice that each area is a composite of several variables and should not be thought of as a single variable.)

A. Following the Format

The pictures and tasks in the Distar Program are not designed to provide you [the teacher] with points of departure for discussions. They are designed to achieve very specific objectives. These objectives will not be met if you talk too much, if you allow the children to make too many extraneous observations, or if you depart from the task as it is specified in the program.

Use the exact wording provided in the materials, and do not make additional statements or ask additional questions unless the format calls for them. Let the children know that you are on the task. Discourage irrelevant observations. (Engelmann & Osborn, 1970, p. 12)

B. Signals

Use clear signals for the children to respond, so that they all respond at the same time. The children aren't performing acceptably unless all of them respond appropriately to every question. If some do not respond to a question, the group's response is unacceptable. In such a situation, some children may be learning to listen to what others say and imitate their responses. . . . With clear signals, you will be able to get much more accurate feedback from the performance of the different children in the group. (Engelmann & Carnine, 1972, p. 14)

C. Corrections and Criterion Teaching

Correct only the part of the exercise the child had trouble with. Correct the mistake immediately after it occurs. After correcting the child on the part of the task he missed, always return to the beginning of the exercise and repeat the exercise. The reason for this procedure is that the children must learn to see each exercise as a series of steps. The steps do not occur in isolation. They are related to a goal and to certain rules.

Unless you always repeat a task from the beginning and do not conclude that the children have been corrected until they can go through the entire exercise without making a mistake, the children may learn to handle each of the steps without ever seeing how the steps fit goethher in a pattern.

> Remember--after every mistake return to the beginning of the task and take the entire group of children (not merely the child who made a mistake) through the exercise from the beginning, either until the children are firm or until they make their next mistake (at which time you correct and then return to the beginning of the task). (Engelmann & Carnine, 1972, p. 14)

D. Praise and Feedback

> Reinforce the children who are on task. Follow the rule of catching children in the act of being good. Show the misbehaving child that he is receiving no rewards and that the children who are working are receiving rewards. (Engelmann & Osborn, 1970, p. 14)

> Always relate the performance of the children to the rules. Do so in a positive manner. . . . Give the children feedback on each of the behaviors that enter into working hard. This means that you should let the children know when they are working hard. 'Working hard' actually covers a variety of behaviors: giving the correct response; following your presentation--looking at the chalkboard, listening and responding to instructions, answering questions. (Science Research Associates, 1971b, p. 60)

E. Pacing

> Pace your presentations so that you move rapidly in the right places but slowly when necessary. Move quickly enough for the children to see the point of each task--always at a rate that will maintain their interest and enthusiasm. (Engelmann & Osborn, 1970, p. 14)

According to the Distar curriculum authors (Engelmann and his associates), these are the basic implementation variables. It is assumed that if a teacher behaves in these ways the children will achieve the academic objectives of the Distar program. That is, the Distar curriculum developers believe that the above teacher behaviors are directly related to student achievement. The following quotation from the introduction to the Distar two-day orientation-training manual indicates this belief:

> You [the teacher] should learn how to present the tasks so that even the lowest-performing children will learn rapidly. Without this workshop training, the chances are that you will not teach the lowest performers in your class. With the training, however, you should be able to reach children that you have not been albe to reach in the past. The teaching techniques that you practice here will help you become a better teacher of all your children, but will make the biggest difference with your low-performing children (Science Research Associates, 1971b, p. 2)

Development of an Observation Instrument

The development of a set of procedures to record the frequency, content, and sequence of behaviors in a classroom, as well as to rate the quality of instructional activities, is complex indeed. The purpose of this section is not to discuss the issues and problems o developing observation instruments. These are discussed elsewhere (Rosenshine, 1971, 1973; Rosenshine & Furst, 1971). Rather, the translation from in-service training manuals and curriculum guide specifications to the development of a curriculum-specific observation instrument is illustrated for one area of teacher behavior in the Distar program--correction proeedures and criterion teaching. These variables were selected because (1) they are unique to the Distar program and have received consistent and statistically significant support (Siegel & Rosenshine, 1973) and (2) they are the most difficult behaviors for most Distar teachers to implement appropriately.

The Distar teacher in-service training manual outlines the procedures for correcting basic mistakes (Science Research Associates, 1971b). All mistakes are divided into three types--illustrated by the following example: The teacher points to a green triangle and asks, "What shape is this object?" A child may respond, "A square." This type of mistake represents a lack of

information; the child confuses a triangle with a square. A second response, illustrating a motor or speech problem, is "Why-angle." The child cannot clearly pronounce "tri." A third child may not understand the signal. He responds, "Green." Th signal was not "What color is this object?" The child did not understand what he was being asked; he answered a different question.

The teacher is taught to correct differentially these three types of mistakes:

Type I Mistake--Lacks Information

1. Teacher gives the answer (A) or provides additional information (A_1):
   "A triangle."

   "Giving the answer" (A) is simply telling the child the correct response.

   "Providing additional information" (A_1) is not telling the child the entire answer but merely providing extra information so that the child can "come up with" the correct response.

2. Teacher tests the child by repeating the segment missed (T):
   "What shape is this object?"

   "Testing the child or children" (T) is asking the question again or requiring the child(ren) to respond.

Type II Mistake--Motor/Speech Problem

1. Teacher gives the answer (A): "A triangle."

2. Teacher repeats the signal (R): "What shape is this object?"

   "Repeating the signal" (R) is behaviorally identical to testing the child (T). The teacher asks the question again or repeats the command to respond. The difference in labelling is a function of intent. Normally, the teacher does not expect the child to correctly answer when she "repeats the signal." The purpose of this step is merely to call attention to what the children should be responding to.

3. Teacher leads the child (L_n): "Say it with me: TRIangle...again... TRIangle...once more...TRIangle." "Leading" (L_n) is responding with the child. The teacher and the child simultaneously say the response. The "n" indicates the number of times the teacher says the response with the child. Ideally, the teacher should lead two or more times.

4. Teacher tests the child by repeating the segment missed (T): "What shape is this object?"

Type III Mistake--Does Not Understand Signal

1. Teacher repeats the signal or calls attention to the signal (R): "Listen: What shape is this object? Shape."

2. Teacher or another child models the response (M): "Let's listen to Anthony do this. Anthony, what shape is this object?" "A triangle," he responds.

   "Modeling" (M) is performing the teacher's part and the child's part. This is done to demonstrate to the child how the two parts are related. The teacher asks the question and then answers the question. Note that in giving the answer (A), the teacher only answers the question.

3. Teacher tests the child by repeating the segment missed (T): "What shape is this object?"

An eight-point rating scheme was devised. The scale reflects the thrust, purpose, and logic of the correction paradigm--namely:

a. There are two main steps the teacher should follow when correcting basic mistakes: do something that will prevent the mistake from occurring again and redo the segment of the task taht was incorrect.

b. What the teacher does to prevent the mistake from occurring again is a function of the type of mistake (see above).

c. The teacher must always test the child by repeating the segment missed. If the child responds correctly, the teacher may proceed. However, if the child responds inappropriately, the teacher must again correct the mistake (provide additional information, lead, model, etc). This testing insures the children's mastery performance.

d. No mistake should be ignored.

The teacher's handling of each mistake is rated according to the following scale:

8: Teacher corrects the mistake immediately after it occurs and according to the above procedures. Then the teacher tests the child (or group) by repeating the segment of the task that was missed. (Example for Type I mistakes: A, T)

7: Teacher pairs the type of mistake with the correct procedure as indicated above but adds additional procedures and tests. (Examples for Type I mistakes: M, T; M, L_1, T; R, A, T)

6: Teacher pairs with type of mistake an incorrect procedure (and/or omitting appropriate steps) and tests. (Examples for Type I mistakes: L_2, T; R, $L_1$1 T)

5: Tests only or repeats the entire task only (Examples: T; E)

4: Like 8 but with no test.

3: Like 7 but with no test.

2: Like 6 but with no test.

1: Teacher ignores the mistake or gives the wrong answer or information.

Criterion teaching is initiated after a mistake has been corrected. The teacher returns to the beginning of the task. According to the authors of the Distar system, this procedure is necessary so that the children learn that each step of a task is related to a goal and certain rules; the steps or questions are not independent. For example, a child makes a mistake in sounding-out the word am; the child says "an." Implementing the correction procedures, the teacher would touch the m and say "mmmmmm." She would then ask the child, "What sound is this?" The teacher would then return to the beginning of the task--requiring the children to sound-out the entire word. Criterion teaching demonstrates to the children that each step is necessary but not sufficient. The goal, in this case, is to read the entire word--not merely to identify the last sound.

The implication for an observation instrument is clear. According to the program authors there should be a one-to-one correspondence between the number of student mistakes and the number of times the teacher returns to the beginning of the task. Therefore, as each mistake is committed, the observer would score a tally if the teacher repeats the task from the beginning. This count is independent, however, of the teacher's rating for correcting the mistake. For example, the students are instructed to sound-out the word am (steps a through d of the format illustrated in Figure 1). The children say aaaaammmmm as they sound-out the word. To actually read the word, they must learn how to put the sounds together and say the word at a normal speaking rate. Thus, at step e the teacher says, "Say it fast." If one or more children say the word at a slower than normal speaking rate (e.g., aaammm), an observer would code this error as a type III mistake (not understanding the signal). The teacher corrects the error and the observer would code the teacher's correction procedure (assign a rating from one to eight). If the teacher then returns to the beginning of the task (step a), the observer would count this as an instance of criterion teaching.

A less rigorous interpretation of criterion teaching could also be measured: (1) Count the number of times during a session that the teacher repeats a segment of the task but not the entire task (e.g., a mistake occurring at step e in Figure 1 and the teacher returning to step c rather than a); (2) count the number of times the teacher recycles through a segment of the task or the complete task but not immediately following a mistake (e.g., a mistake occurring at step e in Figure 1, the teacher proceeding with step f, but then returning to step a or c).

The observation instrument used to code teacher behaviors in the Distar system is program-specific and includes both rating and counting measures of teacher behavior. There are other forms of systematic observation which could be used depending on the curriculum nnd the age of the students. For example, questionnaires have been developed which allow older students tc rate the quality and specify the quantity of certain instructional behaviors--that the teacher is well organized, that the teacher's presentation is clear, or that the teacher responds to student ideas. Although many of these student questionnaires are program-general, there has been some work to develop instruments which focus on those specific instructional activities which are emphasized by the curriculum planners (see, for example, Kochendorfer, 1966, or Walberg and Anderson, 1967).

Summary of Results for Distar Research

In two studies (Siegel & Rosenshine, 1973), it was determined that teacher behaviors that were considered important for successful program implementation (following the format, using appropriate correction procedures, teaching a format to criterion, requiring unison responding to signals) were related to student achievement. The correlational analysis showed that in a predictive sense:

1. It is not only important to attempt to correct mistakes when they occur, but it is also important to correct the mistakes according to the correction paradigm.

2. It is important that the teacher get unison responses from the group. That is, none of the children should be allowed to prompt other children's responses.

3. Praise for appropriate responding and attending behavior is *unimportant*. This, of course, does not mean that it is unimportant for things other than achievement, for example, humaneness or civility or positive self-image.

4. It is important to follow the format--both for group and individual tasks. Slight modifications in the format are permissible.

Furthermore, a later study (Siegel, 1973) provided experimental support for specific correction procedures and criterion teaching--two categories of behaviors which are characteristic of the Distar curriculum package (See Figure 2). Randomly-selected groups of high and low implementing teachers were retrained in techniques of a) correcting students' mistakes according to a prespecified procedure and b) recycling through an instructional task until all of the children in the group respond without error. As a result of retraining, the 23 experimental teachers performed at a significantly higher level of implementation that the 27 "control" teachers (those not

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Insert Figure 2 about here

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retrained). In fact, the performance of the *experimental low* implementors was superior to the performance of the *control high* implementors after retraining. In addition, there were significant differences in achievement (favoring the experimental group) on the students' post-test scores after they were statistically adjusted for the differences on the pre-test scores. Thus, significant changes in teacher behavior (and particularly along the dimension of criterion teaching--the behavior of repeating the entire task after a mistake has been corrected) apparently caused significant changes in

student achievement (on both a program-specific and program-general criterion-referenced measure).[3]

Perhaps the most important aspect of these studies was obtaining a functional relationship between teacher behavior and student achievement in a highly-structured curriculum such as the Distar program. This suggests that even in a curriculum program that controls teacher behavior to the extent that it specifies word for word what to say to a group of students, there remains a large amount of variation in both teacher behavior and student performance. This underscores the importance of studying the kinds of variation in teacher behavior that produce desired changes in student behavior.

Implications for Training Distar Teachers

These studies support the hypothesis that teaching each format to criterion (or mastery) results in superior achievement performance. The goal of criterion teaching is that every child in the group will be able to respond correctly to every segment of the format, from beginning to end, without being corrected. And unless a teacher can effectively correct mistakes, it is unlikely that every child in the group can respond correctly to every segment of a task without any prompting from the teacher. Thus, a teacher's ability to correct mistakes is logically related to her ability to teach a format to criterion.

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[3]The discussion of measures of student outcomes (achievement, attitudes and dispositions to act, and personal development) has not been included here. This omission is not intended to minimize the issues. Two papers by Rosenshine (1970, 1971) are recommended as an introduction to this complex problem.

The retraining program used in the above study presented a correction paradigm which at step three emphasizes criterion teaching: 1) do something that will prevent the mistake from occurring again (a different procedure is suggested for each type of mistake--lack of information, motor or speech problem, or not understanding the signal); 2) redo the segment of the task that was incorrect; and 3) redo the task from the beginning with the entire group. If a child makes a mistake at step two or at step three, the teacher returns to step one. This procedure is continued until all children in the group can perform all segments of the format--from beginning to end--without error.

Unfortunately, merely describing and demonstrating a procedure to a group of teachers does not insure that the teachers will successfully implement the paradigm. As a result of this form of training, teachers can often verbalize the correction and criterion teaching procedures but rarely can *behave* in a manner consistent with the paradigm.

An alternative form of training was used successfully in the reported study. During the retraining workshop the teachers progressed through a series of exercises which successively approximated actual teaching situations. The teachers would present in unison a format to the trainer who would act the part of a child.[4] At various points in the task, the trainer would make a mistake. The teachers would then correct the mistake according to the paradigm. If one or more of the teachers in the group *inappropriately corrected* the mistake, the trainer would: 1) explain the proper procedure;

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[4]Unison responding is efficient, provides group support, and requires that all teachers participate (as opposed to working in small groups which usually leads to off-task behavior).

2) make the mistake again so that the teachers could appropriately correct it; and 3) require the teachers to return to the beginning of the task. In other words, the trainer would correct the teachers' procedural mistakes in the same way the teacher would correct children's mistakes.

A similar procedure was used later when the trainer worked with each teacher in the classroom with her own students. If the teacher did not perform the correction and criterion teaching paradigm appropriately, the trainer would interrupt the presentation, provide feedback to the teacher, and require the teacher to return to the beginning of the task. Although one might suspect that the teachers would be upset by this, *each* teacher verbally expressed enthusiasm for the procedure; and many teachers requested further training. This positive attitude towards training may have been due in part to the dramatic improvements in student performance, as reported by the teachers, during the few days between the workshop and the classroom visit.

These training procedures are not unique, however, Bushell, while training teachers to implement his Behavior Analysis Follow-Through Program, used similar procedures:

> We began with a summer institute. We had clear effects on the attitudes of the participants--they loved it. We measured to see whether there was any change in what they were doing in the classroom after they got home and found none. So we abandoned summer institutes. The other thing we're taught to do as professionals is to be consultants--wise men who drop in and tell everybody how to do it right. We sent a polished consultant from district to district and would take data on some specific aspects of teaching and learning before the arrival of the consultant and after his departure. And without knowing his travel schedule, we couldn't tell when he had been there. So we dropped consultants.
>
> In one eastern city, the entry point was obtained through sheer desparation. We brought everybody together for three days and literally stood beside each one of them and said, 'Do it this way.'

> For some reason it had a huge effect, although there's nothing in my background that suggests that that's an appropriate way to do it. (Maccoby & Zellner, 1970, p. 110)

A General Research Strategy

The descriptive-correlational-experimental loop paradigm is perhaps most readily understood within the context of a behaviorally oriented or structured curriculum program such as the Distar Instructional System. Yet it is proposed that this research strategy would be applicable to less structured and more "open" curricula as well.

Table 1 illustrates this application and suggests various program-specific (important) process variables and possible outcome variables for three early childhood programs.

The program implementation (process) variables and outcome variables are primarily determined by the curriculum developers but may or may not be stated explicitly. Furthermore, the behaviors which are emphasized during pre-service and inservice teacher training may vary from what is expressed in the writings (journal articles, books, teacher guides, etc.) of the curriculum designers. Nevertheless, the researcher and program developer must ultimately concur on the implementation variables and on the procedures and instruments used for collecting teacher and pupil data. If this were not the case, then the program developer could argue--justifiably--that the researcher's study did not test the program's implementation variables. It would be rather difficult for a researcher to justify the inclusion of a particular "program-specific" variable on an observation instrument when this claim is denied by the program authors. A compromise solution, however, is possible. The

Table 1

Examples of Process and Outcome Variables for Three Early Childhood Education Programs

Program	Example of Process Variables	Example of Outcome Variables
The Engelmann-Becker Program (Engelmann and Becker, sponsors)	Following the format for group and individual activities; Correcting all mistakes according to a pre-specified paradigm; Teaching all formats to criterion (mastery); Requiring unison responses to signals.	Reading, language, and arithmetic achievement measures--criterion-referenced and norm-referenced.
The Cognitively Oriented Approach (Weikart, sponsor)	Arranging the environment so that the child can actively interact with it; Allowing the child to establish the learning pace; Arranging the curriculum so that it progresses from the simple to the complex--from the concrete to the abstract.	Rating scales to measure effects on socioeconomic development; Measures of language development; IQ; and Academic achievement measures.
EDC Program (Armington, sponsor)	Teacher flexibility; Ability to pose questions; Helping child to verbalize and to formulate his ideas and thoughts; Emotional climate established by the teacher; Arranging the environment for corrective feedback; Allowing the child to engage and disengage from a task at the child's will.	Measures to assess student initiative and self-direction, curiosity, and imagination, openness to change, self-respect and respect for others; Concentration, listening and remembering.

Note: The description of variables for each program was inferred from the literature; program authors for each curriculum may disagree with the wording or emphasis in this table. The purpose here is to illustrate the versatility of the descriptive-correlational-experimental loop research paradigm and not necessarily to give an accurate description of process and outcome variables for specific programs.

The observation instrument could reflect three types of variables: those variables which the curriculum developers *and* researchers hypothesize to be important for the success of the program, those variables which only the curriculum developers hypothesize to be important, and those variables which only the researchers hypothesize to be important. The research would then reflect each group's biases. This procedure could be expanded to include implementation variables which are specific or important to other curricula, as well as variables (especially outcome variables) which are important to different groups (parents, educators, legislators, students, etc.). For example, Armington would be concerned with measures of curiosity and imagination for children in the EDC Program whreeas many parents may be concerned with measures of reading and arithmetic achievement. Both sets of variables could be collected--not only for the EDC Program but for other programs as well.

The research paradigm, furthermore, does not narrowly specify the manner in which implementation and outcome variables are to be collected. Observation instruments could be used--or possibly student ratings, teacher or parent questionnaires, video tapings, audiotapings, surveys, or a series of "unobtrusive" measures. In fact, certain programs will typically value one form of data collection over another. For example, the Engelmann-Becker Program would be satisfied with norm-referenced and criterion-referenced tests of achievement. The EDC Program, on the other hand, would probably value more indirect measures of student behavior and attitude. Again, many types of measures could be used for each program if more generalizable relationships are of interest.

Implications for Teacher Education

A major concern implied in the introduction to this chapter is whether or not generalized teaching behaviors are of importance to the implementation of curriculum programs. It was suggested that teacher behaviors which are specific to a program may be more important in influencing student outcomes than teacher behaviors which apply to a wide range of progrmss. Indeed, no teacher teaches the curriculum "first grade reading;" she teaches the SWRL Reading Program, the Bank Street Readers, IPI, Addison-Wesley, Distar Reading, McGraw-Hill, SRA Reading Labs, or another reading program.[5] Teacher behaviors which are critical to the success of one program may not be very important to the succees of another--or may even be detrimental.

Granted, there are similarities among programs. For example, a teacher surely would not have to learn a new set of teaching skills when she teaches Distar Reading after having taught Distar Language. Likewise, there are certain similarities among programs oriented toward cognitive growth, between curricula oriented toward behavior modification, and so on. However, it is hypothesized that as the classification becomes more encompassing--goes beyond a specific curriculum program to include programs of a general type and ultimately, models of instruction--the probability *decreases* that any teacher

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[5] Furthermore, some teachers teach no identificble reading program. Rather it is a mixture of the text (or several programs), experience, and casual practice. In this case, the issues become more complex because of these ambiguous interactions.

behavior that applies to all programs of the larger set will be a powerful variable (that is, will account for a large percentage of the variance in the outcome measures) for all programs of one or more subsets.[6]

Pre-service Education

Teacher training programs which emphasize general strategies for teaching may be providing information for the school teacher which is less than useful. Rather, would-be teachers could profit more from learning to teach a sample of program types and the behaviors crucial to each. For example, a student teacher interested in early childhood education could learn to implement three or four curriculum programs which sample a wide range of instructional strategies: say, Gilkeson and Zimiles' Bank Street Program, Bushell's Behavior Analysis Program, Gordon's Florida Project, and Weikart's Cognitively Oriented Approach. Or rather, if a more specialized training were desired, the set would include only programs of a certain type: for example, Engelmann's Distar Program; Bushell's Behavior Analysis Program, and Resnick's Primary Education Project. Thus, teacher behaviors which are specific or important to a particular program may be learned as well as those implementation behaviors or instructional activities which are generally important for the success of several programs.

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[6]No matter what the criteria chosen for the grouping and classification of programs--age, grade level, subject matter, mode of teaching, psychological orientation, etc.--it is hypothesized that this holds true.

In-service Education

In-service training should abandon teacher institutes which focus on general instructional activities, methodologies, philosophies, or practices. Instead, the training should emphasize those competencies or behaviors which are necessary to implement the curriculum programs that the teachers use in the classroom.

This implies new roles and responsibilities for curriculum publishers and authors as well as for school supervisory personnel:

1. The program developers must clearly specify those instructional activities which are critical to the implementation of the curriculum. Vague prescriptions will likely result in wide variation in teacher implementation.

2. School administrators must demand that publishing houses provide adequate training programs. Even well-written teacher guides are often inadequate training tools.

3. The school administrators must also provide a sufficient amount of time for the teachers to receive the available training.

4. Teacher supervisors (curriculum facilitators) must monitor the degree to which the teachers are appropriately implementing the curriculum materials package. The curriculum facilitator must review the skills taught at training sessions, prompt critical behaviors in the teacher, aid the teacher in learning to change his behavior, assist administrative personnel evaluate the teacher, and provide information about skills which need practice during in-service workshops.

5. And finally, the curriculum authors and publishers must demonstrate that there is a functional relationship between the teacher implementation behaviors and student outcomes of interest. It is unfortunate that most school administrators do not demand this evidence before committing substantial funds for curriculum materials.

> We are now beginning to recognize that simply developing a curriculum materials package, an instructional method, or an educational innovation is not sufficient; we are now beginning to recognize that studying the way an educational product is used in the schools is at least as important as developing the product. But we have spent too little time and money studying how products are used and modifying products on the basis of such study. (Rosenshine, 1971, p. 70)

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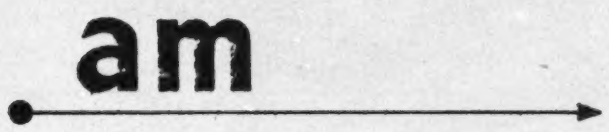
Figure Captions

Figure 1. Example of a format in the Distar Reading I program. (From Distar® Reading I, Second Edition, Teacher Presentation Book A by Siegfried Engelmann and Elaine C. Bruner. Copyright 1974, 1969, Science Research Associates, Inc. Reprinted by permission of the publisher.)

Figure 2. Scope and sequence of the descriptive-correlational-experimental study for the Distar Language program (Siegel, 1974).



TASK 13 CHILDREN SOUND OUT THE WORD AND SAY IT FAST

a. *You're going to read this word. You're going to sound it out and say it fast.*

b. Touch the ball for am. *I'm going to follow the arrow and touch the sounds. When I touch the first sound, you say it. Keep on saying it until I touch the next sound. Don't stop between the sounds.*

c. *Sound it out. Get ready.* Move to a. aaa. When aaa is firm, move quickly to m. The children are to say aaammm without pausing between the sounds.

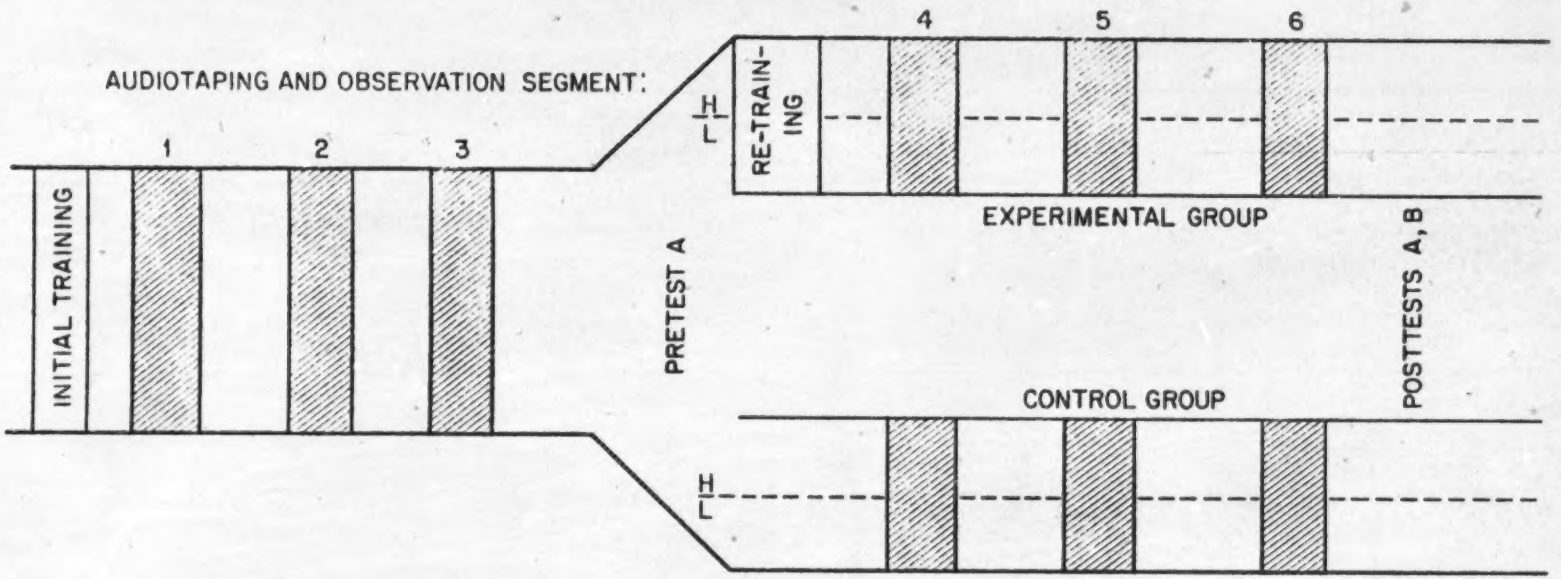
d. Return to the ball. *Again.* Repeat c until firm.

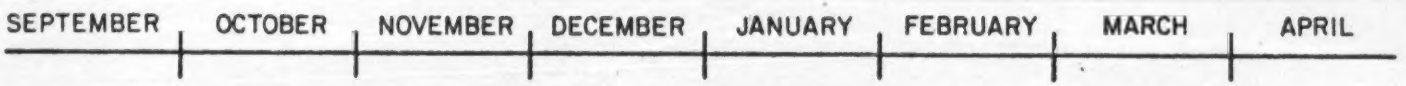
e. When aaammm is firm, say: *Say it fast.* (Signal.) Am.

f. *What word did you read?* (Signal.) Am. *Yes, am. Good reading.*

TASK 14 INDIVIDUAL TEST

Call on different children to sound out the word in task 13 and say it fast.


AUDIOTAPING AND OBSERVATION SEGMENT:
1
2
3
4
5
6
INITIAL TRAINING
RE-TRAIN-ING
PRETEST A
EXPERIMENTAL GROUP
POSTTESTS A, B
CONTROL GROUP


SEPTEMBER
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